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13. ABSTRACT *(Maximum 200 words)*

Two multiple-access signaling techniques of current interest for mobile communications are broadband code-division multiple-access (CDMA) and narrowband time-division multiple-access (TDMA). This project examined the relationship between signal design and system performance for each of these techniques. System performance for fading, multipath channels was emplasized. Analytical tools were developed for that purpose, and performance was investigated for a wide range of system and channel parameters. The final report provides a summary of the work.

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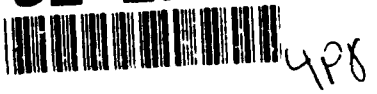

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Project Final Report
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Daniel L. Noneaker: Project Director
University of Illinois

Two multiple-access signaling techniques of current interest for mobile communications are broadband code-division multiple-access (CDMA) and narrowband time-division multiple-access (TDMA). This project examines the relationship between signal design and system performance for each of these techniques. System performance for fading, multipath channels is emphasized. Analytical tools are developed for that purpose, and performance is investigated for a wide range of system and channel parameters.

The performance of CDMA systems is shown in this project to be highly dependent on the choice of direct-sequence (DS) spread-spectrum waveforms employed. The degree of dependence is a function of both the statistical characterization of the communications channel and the receiver architecture. This work examines both correlator receiver performance [1,2] and Rake receiver performance [3,4]. For each type of receiver it is shown that DS waveforms can be selected which yield good system performance over a range of channel delay spreads and Doppler spreads. In addition, it is shown that the DS waveforms can be selected to yield good performance as the number of Rake receiver taps is varied.

Prior analyses of narrowband systems employing phase-shift keyed (PSK) modulation for fading, multipath channels have been restricted to binary and four-phase signaling. In this project, analytical expressions have been derived for the bit and symbol error probabilities of PSK and differential PSK of arbitrary symbol alphabet size [5,6]. The error probability expressions are applicable to equal-gain or maximal-ratio diversity combining and a broad

class of fading, multipath diversity channels. These expressions provide the analytical tools necessary for future investigation of coded or uncoded bandwidth-efficient signaling techniques.

In this project, the effects of signal design on system performance have been investigated for both narrowband and wideband multiple-access systems. It is concluded that careful assignment of wideband signaling waveforms can significantly enhance the performance of a CDMA system. In addition, analytical tools have been developed to facilitate the study of bandwidth/performance tradeoffs for narrowband TDMA systems.

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